

Trip Report for 2012 WRF User's Workshop

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The WRF User's Workshop and related activities were held from 25-29 June 2012 at NCAR in Boulder, CO. A lecture series on cumulus parameterization was held from 1-5 pm on Day 1, with a WRF Data Assimilation Working Group meeting was held in parallel (I attended the lecture series). The Workshop proper was held from 8:30 am – 5:30 pm Days 2-4, with plenary sessions on WRF software updates, forecast system development, physics development and testing, model evaluation, model coupling and new model development. The WRF/Chem Developers Group met on Day 2 from 12:00-1:15 pm. A poster session was held on Day 3 from 2:00 to 5:30 pm. Parallel sessions on chemistry, regional climate, and data assimilation were held on Day 4 from 8:30 am – 12:30 pm (I did not attend the chemistry and data assimilation talks). On Day 5, several parallel “short courses” were offered from 8 am – 12 pm on regional climate downscaling, VAPOR, IDV, NCL and an introduction to verification methods; I only attended the regional climate downscaling tutorial.

Key points:

1. The next WRF release will be 3.4.1, expected in August. It will primarily be a bug-fix release, but may include some new “safe” features that missed the cut-off for 3.4.
2. NCAR plans to change the vertical coordinate for WRF from sigma to a hybrid sigma-pressure (similar to NMM and GEOS-5). This requires significant changes to the code, and will break backward compatibility with wrfinput/wrfbody files produced with 3.4.1 and earlier versions. The new coordinate is expected to be in the WRF release in April 2013, which would be dubbed WRF 4.0.
3. John Michalakes (NERL) has experimented with a new WRF I/O mode, using Parallel netCDF with quilting. This new option showed significant reduction in write times, especially for large domains. He indicated this is available in WRF 3.4 (the ARW User's Guide briefly described linking to Parallel netCDF and using the quilting options).
4. The Developmental Testbed Center (DTC) has evaluated a number of WRF configurations, with a heavy recent emphasis on forecast operations with AFWA and NWS. Reports are available at <http://www.dtcenter.org/eval/>, and sample input files are available at <http://www.dtcenter.org/repository/>.
5. The WRF/Chem Developers Group plans to create three reference cases for users to work with. They also indicated that WRF/Chem is unlikely to work with emissions data when using moving nested grids, although normal gridded fields and lateral boundary conditions should update.
6. A number of (unanswered) questions were asked about proper physics selections. During the lecture series on Day 1, multiple comments were made on the “grey zone” of resolutions from 5 to 20 km, where cumulus schemes are needed but their assumptions on what is “sub-grid scale” are often violated. Dave Stensrud (NSSL) noted that the Betts-Miller-Janjic and Arakawa-Schubert schemes were not designed to run with microphysics; however, the NWS routinely runs these schemes with microphysics anyway.

7. Georg Grell (ESRL) has some experimental changes to the G3 cumulus scheme, adding an autoconversion term that is a function of aerosol content. These changes will likely be added to the next major release of WRF. Grell also plans to explore a new “unified” approach based on Arakawa et al. (2011, Atmospheric Chemistry and Physics; see <http://www.atmos-chem-phys.net/11/3731/2011/acp-11-3731-2011.pdf>) where the vertical eddy transport equation is rederived to **not** assume eddy area fractions $\ll 1$; in theory this would make the G3 scheme more applicable to high-resolution domains.
8. Some questions were also asked about vertical resolutions. Many presenters reported having “good” results with as few as 30 levels. Geoff DiMego (NCEP/EMC) commented that the operational models have many levels to improve data assimilation.
9. NCAR is working on a ‘WRF/Hydro’ extension package to facilitate coupling WRF with hydrology models (alternative versions have also been created for CESM and LIS). This new package may be released next April.
10. Some practical advice was given on using spectral nudging in WRF (from a regional climate perspective). Tanya Otte (EPA) reported the importance of choosing correct nudging coefficients, of including moisture, and turning off nudging both in the PBL and in the stratosphere (in the latter case, this required code changes). A peer-reviewed paper by Bowden et al. (2012, Journal of Climate) discusses some of these points (see <http://journals.ametsoc.org/doi/pdf/10.1175/JCLI-D-11-00167>). In contrast, Cindy Bruyere (NCAR) warned it is very easy to overnudge towards the lateral boundary conditions, and suggested avoiding this option (or at least avoid it in innermost domains and especially small area domains).
11. Several NCAR presenters strongly advised reading a recent BAMS article by Warner (2011) when configuring WRF (or any other NWP model). It presents a nice review for how modeling studies should be done. See <http://journals.ametsoc.org/doi/pdf/10.1175/BAMS-D-11-00054.1>
12. NCAR’s new Model for Prediction Across Scales (MPAS) continues to mature, and may be released later this year or early next year to friendly users. This new non-hydrostatic model uses centroidal Voronoi tessellations to create a “soccer ball” grid over either limited areas or the entire globe, with optional variable horizontal resolutions to add finer resolution in specific regions. (An experiment is planned to run MPAS with $dx=100$ km globally, decreasing to $dx=3$ km over CONUS.) A paper summarizing MPAS by Skamarock et al. is in press in Monthly Weather Review (see <http://journals.ametsoc.org/doi/pdf/10.1175/MWR-D-11-00215.1>). In previous workshops, it was implied that MPAS would replace WRF at some point, but the MPAS developers stressed they are currently focused on global and regional climate (the next CAM/CESM will be based on MPAS, and some regional climate experiments are planned for comparison with NRCM). A subset of WRF physics and numerics has been ported to MPAS, and it is possible a subset of WRF/Chem will be ported as well. (Some data assimilation work is underway with the NCAR DART group, but this is immature and may not be publicly available for a while.)